8. Fuel Diversity

8.1 Defining Fuel Diversity

The variety and proportions of energy sources used to power New Hampshire is often referred to as our state's "fuel diversity." By having a variety of energy sources available, the state can spread risk and opportunity across a wide variety of fuels, taking advantage of emerging technologies and in-state resources while buffering us from price swings for any one particular fuel type.

It is the energy policy of the State of New Hampshire that the needs of citizens and businesses be met while "…providing for the reliability and diversity of energy sources…" NH RSA 378:37. New Hampshire has long enjoyed a diverse mix of energy sources, and this has helped provide our consumers with some level of price stability over time.

Proponents of policies to increase fuel diversity note that having a variety of fuel sources available for energy needs – including electricity, transportation, heating and other uses – provides numerous benefits, including:

- Competition among different fuels to provide the least-cost energy to consumers, helping to lower overall prices;
- A hedge against significant price increases for any particular fuel type;
- An energy system that is less subject to exchange rate fluctuations and geopolitical uncertainties often associated with imported fuels;
- Encouraging emerging technologies to participate in the energy market, driving commercialization of renewable and more efficient fuel uses; and
- Encouraging the use of indigenous fuels as part of the energy mix, often with significant positive economic and environmental benefits for the local area as well as for the state as a whole.

8.2 Overview of NH's Current Fuel Diversity

8.2.1 Electricity Fuel Mix

Annual electricity generation by plant and fuel type, as well as total generating capacity by plant and fuel type, were presented in Section 6.3, the Supply section of the chapter on Electricity. Here we consider these same data in terms of shares of total – for example, share of total capacity, generation, and consumption.

As shown in Table 8.2, in the year 2000 Seabrook station accounted for greater than 40% of the total generation capacity in the state, followed by coal, then gas/oil steam, and then hydro, each between 15 and 21%. The biomass plants represent just under 3% of capacity in 2000. Capacity refers to the ability of a plant to produce electricity, and is not the same as generation, which is the actual amount of energy actually produced by a facility.

By 2005, major new natural gas combined cycle plants will be online, accounting for approximately one quarter of total generating capacity in the state. In the Base Case these shares stay essentially fixed, except for the assumed retirement of the biomass plants by 2010 based upon the expiration of their current rate orders.

Table 8.1 New Hampshire Generation Share by Plant

Base Case Forecast New Hampshire Generation Share by Plant (%)					
	2,000	**2,005**	**2,010**	**2,015**	**2,020**
Gas/Oil Turbines	0.3%	2.2%	3.6%	5.0%	5.3%
Gas/Oil Combined Cycle	0.0%	5.3%	9.0%	14.9%	23.4%
Gas/Oil Steam	10.0%	9.0%	8.8%	8.0%	7.2%
Coal Steam	21.0%	18.9%	18.4%	16.9%	15.0%
Nuclear	55.4%	53.0%	51.7%	47.4%	42.2%
Hydro	8.6%	7.8%	7.6%	6.9%	6.2%
Biomass	3.8%	2.8%	0.0%	0.0%	0.0%
Landfill Gas/Waste	1.0%	0.9%	0.9%	0.8%	0.7%
Wind	0.0%	0.0%	0.0%	0.0%	0.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Shares of actual generation by fuel type are shown in Table 8.1. Nuclear power's variable cost – which is the incremental cost of operating the station to generate power, rather than leaving it dormant, and generally reflects cost of fuel – is very low, so it operates as a baseload plant, meaning that it runs whenever available to the grid. As a result, while Seabrook represents 41.6% of capacity in 2000, its annual output (generation) is 55.4% of in-state generation. In other words, the actual output from Seabrook in the year 2000 exceeded the output from all other electric generating stations in the state combined. This share is forecast to decline somewhat in the future as more capacity is added, especially through natural gas plants. Even so, by 2020, Seabrook is still forecast to account for over 40% of total annual generation. By

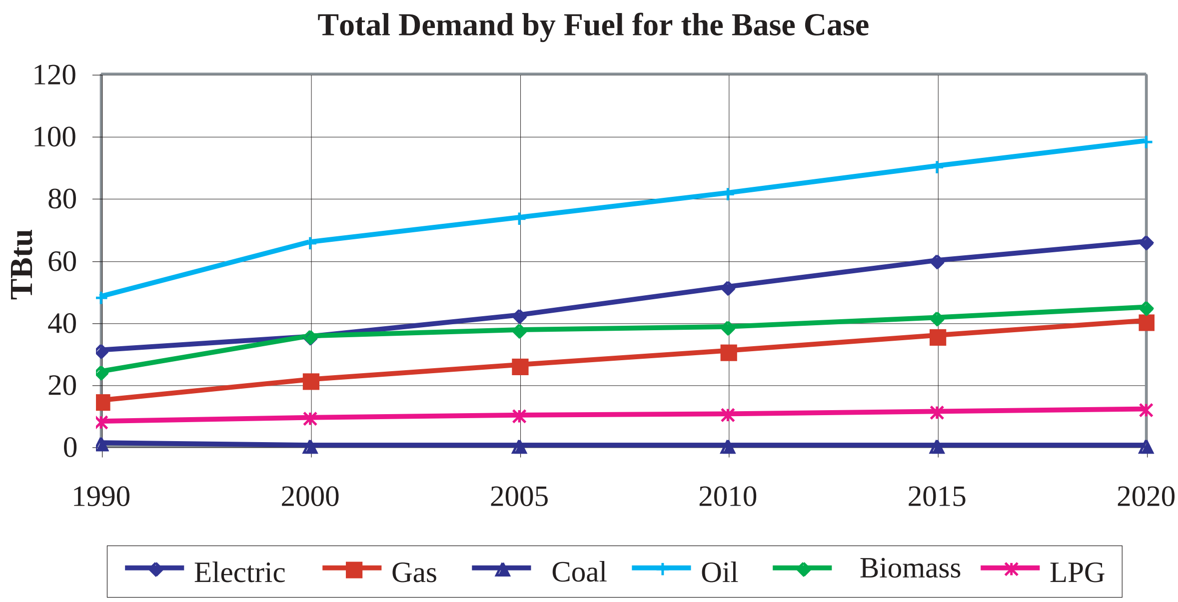


Figure 8.1 Energy Demand at Point of Use, by Fuel

contrast, while hydro plants represented 16% of the state's capacity in 2000, they accounted for only 9% of the state's actual generation. This is largely because hydro facilities operate only when water is available to power them and, unlike other forms of electricity generation, are not available all of the time.

Table 8.2. New Hampshire Generating Capacity Share by Plant

Base Case Forecast New Hampshire Generating Capacity Shares by Plant (%)					
	2,000	**2,005**	**2,010**	**2,015**	**2,020**
Gas/Oil Turbines	0.5%	7.0%	7.1%	7.1%	7.1%
Gas/Oil Combined Cycle	0.0%	25.7%	26.1%	26.1%	26.1%
Gas/Oil Steam	18.3%	12.1%	12.3%	12.3%	12.3%
Coal Steam	20.4%	13.5%	13.8%	13.8%	13.8%
Nuclear	41.6%	29.3%	29.7%	29.7%	29.7%
Hydro	15.8%	10.5%	10.6%	10.6%	10.6%
Biomass	2.8%	1.5%	0.0%	0.0%	0.0%
Landfill Gas/Waste	0.7%	0.5%	0.5%	0.5%	0.5%
Wind	0.0%	0.0%	0.0%	0.0%	0.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

8.2.2 Fuel Diversity in Energy Demand

At point of use – combining the residential, commercial, industrial and transportation sectors – oil accounts for the largest single share of use energy, at just over 65 trillion Btus in the year 2000, as shown in Figure 8.2. Electricity comes second over the forecast horizon, followed by biomass energy, reflecting the heavy use of biomass energy by the paper industry. (N.B., for these numbers, the electricity line item includes the Btu value of fuel used to generate electricity – including coal, oil, natural gas, and biomass.

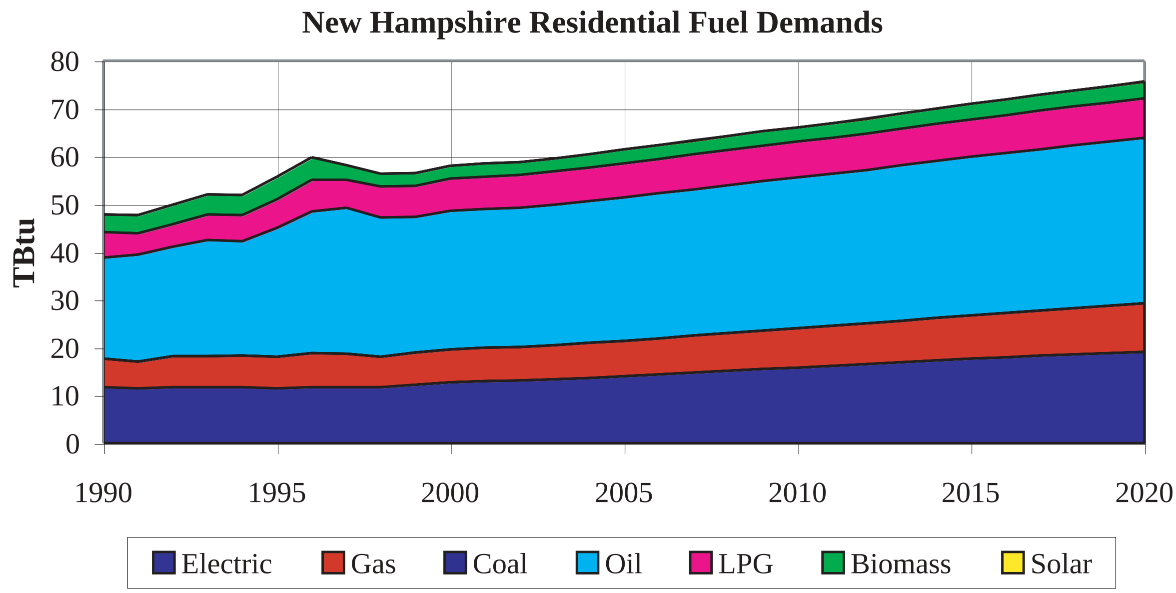


Figure 8.2 Residential Demand by Energy Type

8.2.3 Fuel Shares by Sector

8.2.3.1 Residential Fuel Use

Oil accounts for the largest share of residential energy use, measured in terms of Btu at point of use, followed by electricity, as shown in Figure 8.2. Virtually equal amounts of natural gas and LPG are consumed by New Hampshire's residential sector, and biomass makes a noticeable contribution (just over 5% of total residential energy use) over the forecast period.

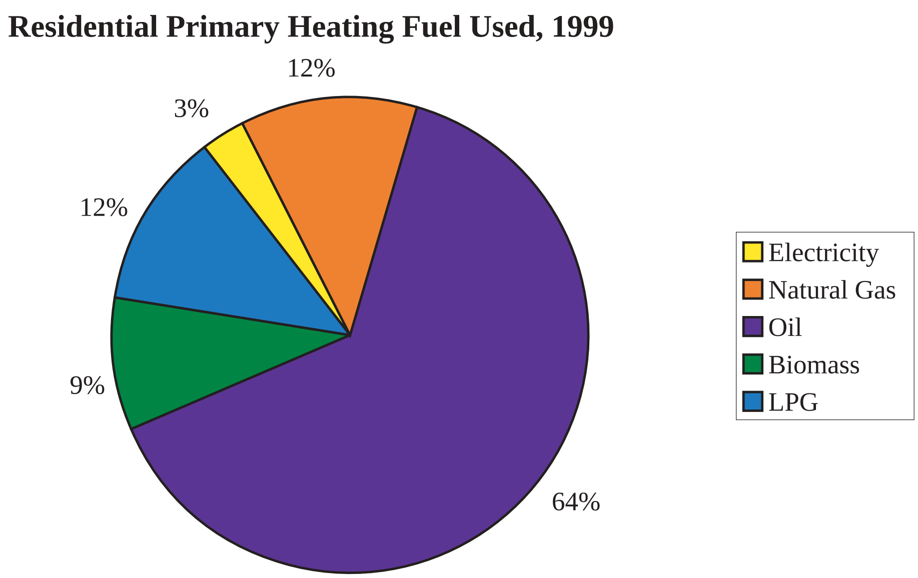
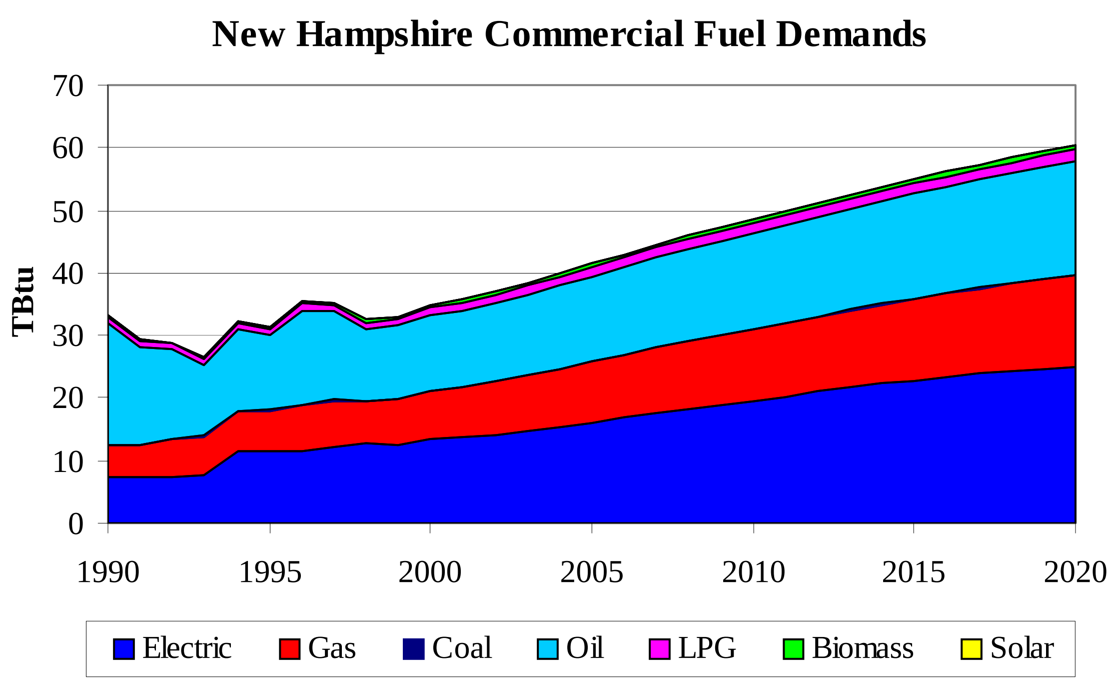


Figure 8.3 Choice of Primary Heating Fuel, Residential 1999 - 2000

Some energy end uses are "substitutable" uses, which means that users can make choices to move from one type of fuel use to another. These kinds of substitution decisions must generally be made at the time of purchase of a new energy-using device. Examples of substitutable end-uses are space heating, water heating, and cooking. Other important end-uses such as lighting, air conditioning, and "miscellaneous" (which refers to home appliances, computers, etc.) are considered nonsubstitutable because they are tied strictly to electricity. Approximately 85,000 residential customers use natural gas in New Hampshire. However, the majority of households lack access to natural gas, so it is not a real option for many residents.

One of the primary uses of energy in residential settings is for heating. The Governor's Office of Energy & Community Services regularly monitors the type of fuel used in New Hampshire households. As shown in Figure 8.3, a survey covering the years 1999 and 2000, New Hampshire households indicated that the majority – 53% – use oil for their primary heating fuel. Natural gas, wood stoves (biomass), and propane are also popular choices.



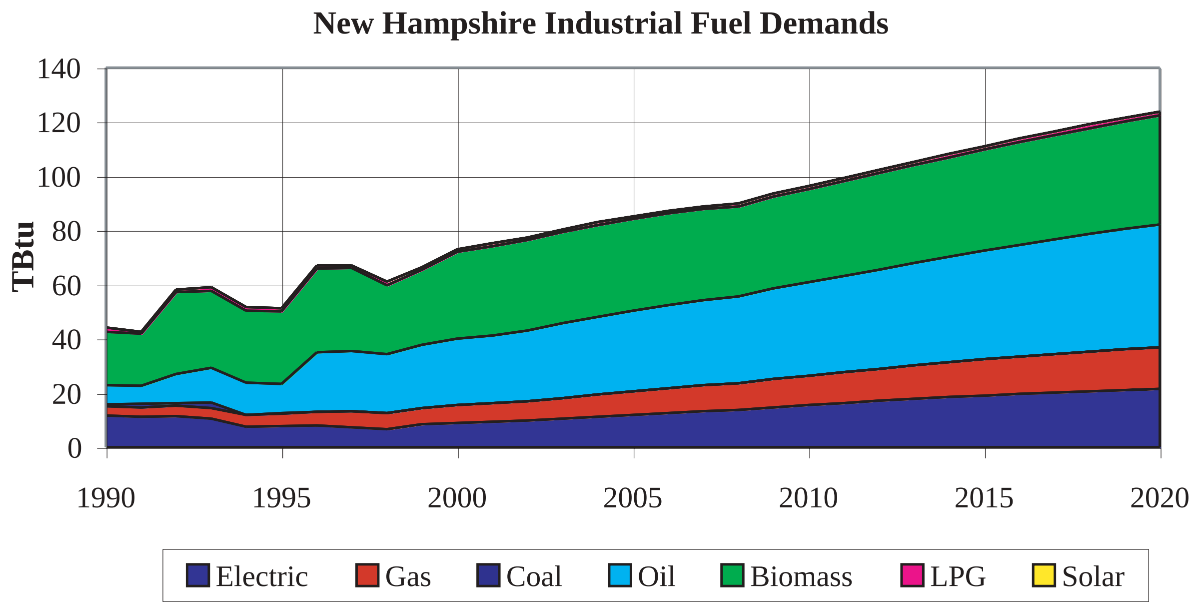


Figure 8.5. Industrial Demand by Energy Type

8.2.3.2 Commercial Fuel Use

Electricity accounts for the largest fuel share in the commercial sector, followed by oil and natural gas, as shown in Figure 8.4. As in the case of residential energy use, only a portion of commercial energy end-uses are "substitutable" end-uses, which means that users can make choices to substitute one fuel for another. In the commercial sector, the non-substitutable end-uses (such as lighting) account for much greater shares of the total than in the residential sector, as shown in Figure 7.4. Overall, in the year 2000, substitutable end-uses made up 63% percent of total commercial energy demand at point-of-use.

8.2.3.3 Industrial Fuel Use

In the industrial sector, oil and biomass play major roles, followed by electricity and natural gas, as shown in Figure 8.5. One of the interesting features of past developments in industrial energy use is the significant increase in the consumption of oil that occurred during the second half of the 1990s.

8.2.4 Transportation Fuels

Transportation energy use is outside the scope of the energy plan called for by the New Hampshire legislature. However, transportation represents our largest use of energy in New Hampshire and in the country, and the following information is intended to help readers better understand how transportation fits into New Hampshire's energy future. Therefore, we have only summarized the Base Case forecast results for transportation, and have not developed or tested any policies that might be directed at increasing the efficiency of transportation in New Hampshire in the future. However, it is clear that this energy use category presents an important topic for future policy development, modeling and consideration.

The bulk of transportation energy use in New Hampshire is associated with the residential sector, which means our own private automobiles, as shown in Figure 8.6. This automobile use is nearly all gasoline, with a very small share of diesel fuel use. As a result, gasoline represents the major transportation fuel used in New Hampshire. Commercial and especially industrial transportation rely more heavily on diesel fuel.

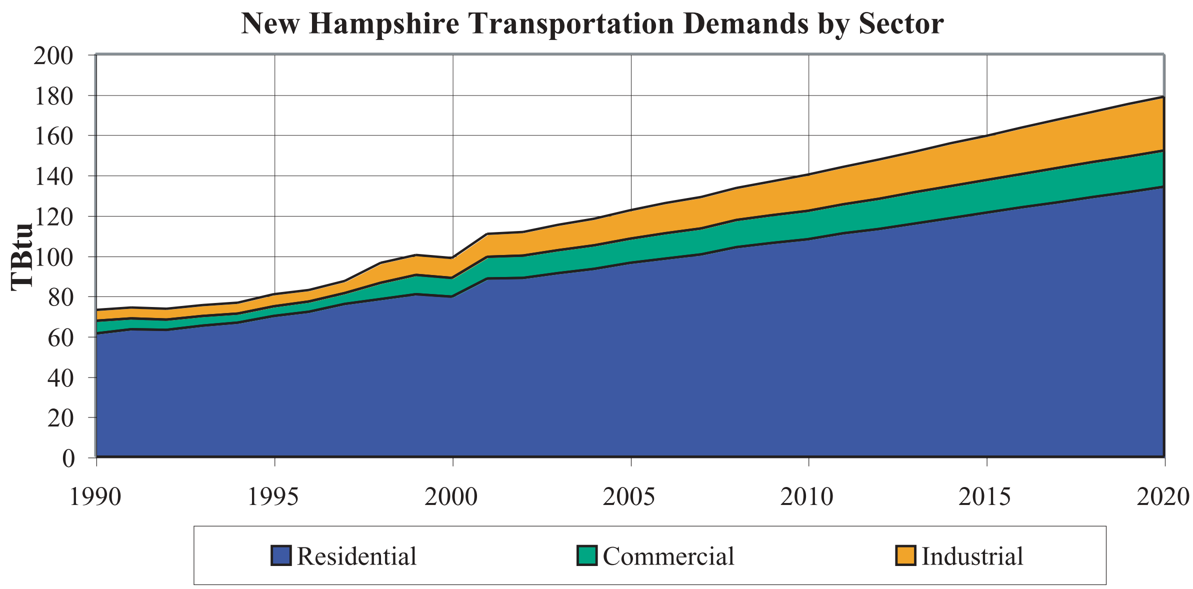


Figure 8.6. Transportation Demands by Sector

The projected growth in energy consumption by private automobiles in New Hampshire between the year 2000 and 2020 is dramatic, reflecting greater than a 50% increase. This corresponds to an increase of over 50 trillion Btus (more than the total energy consumption occurring at point of use in the commercial sector in 2000). This dramatic increase also results in significant increases in emissions of air pollutants, as well as major increases in annual expenditures on transportation (vehicles, insurance, fuel, and maintenance and repair expenses) for New Hampshire residents. Therefore, New Hampshire should include transportation in future energy planning efforts, in order to reap the many benefits of cost effective investments in transportation that result in environmental, economic, public health, and energy benefits for the state.

8.2.5 Current Electric Power Generation Using Alternative Energy

New Hampshire uses a number of renewable and alternative sources of energy to produce electricity and provide heat for residential, commercial and industrial uses. They are discussed below.

Wood Energy

New Hampshire has eight wood-fired power plants that can produce electricity, five of which are presently operating. The future of these five plants is uncertain after their rate orders (contracts mandated by statute that guarantee purchase of their power at predetermined prices) or other agreements to operate expire. Independent analysis of the economics of these facilities completed for the New Hampshire Department of Resources & Economic Development in 2001, as well as market experience with facilities following termination of rate orders, show that these facilities do not operate economically in a fully competitive environment. The five operating wood-fired power plants have a combined output of approximately 77.6 MW, and consume around 1.1 million green tons of wood each year. Wood-fired power plants, and the possible benefits of retaining them, are discussed in further detail in Section 8.3.1 below.

Energy from Municipal Solid Waste

New Hampshire residences and businesses generate roughly 1.4 million tons of solid waste annually. A small portion of this waste is used to fuel two trash-fired energy facilities, one in Claremont and one in Penacook. Both of these facilities are owned and operated by Wheelabrator Technologies, Inc. of Hampton. The facility in Claremont produces roughly 4 MW of power, using almost 70,000 tons of municipal solid waste annually. The facility in Penacook is larger, generating 12.8 MW of electricity through the combustion of almost 175,000 tons of waste each year. Both of these plants operate under rate orders, which guarantee a fixed price for electricity output. These rate orders expire in 2007.

Hydroelectric

Hydroelectric generation plays an important role in our state's energy diversity, with nine utility owned and 27 independently owned hydroelectric generating sites in the state. In 1999, their 440 MW of capacity represented 15.5% of the state's total generating capacity. However, because hydroelectric facilities generate only when water is available, their actual generation is less that their total capacity.

Hydroelectric generation produces electricity using a free renewable fuel source, and has no emissions. Hydroelectric generation does raise concerns about impacts upon both aquatic and terrestrial ecosystems from change in stream flow and impoundments. Based upon existing dams and the lengthy environmental review process that would be required for siting a new project, it is unlikely that many (if any) new sites for hydroelectric generation will be developed in New Hampshire's foreseeable future. Nonetheless, the current hydro facilities in the state are an important part of our overall diverse energy portfolio, and policies that impact them should take this into consideration.

8.2.6 Emerging Issues for Fuel Diversity in New Hampshire

8.2.6.1 Net Energy Metering

Net energy metering allows small renewable power generators to sell electricity back to their utilities at the retail electric rate. For example, net metering allows a household to install a small wind turbine for generation of electricity, while remaining tied to the electricity grid. The household will use electricity from the wind turbine when available, and from the electricity grid when not available. In addition, when the electricity generation from wind is greater than the household's needs, the excess power is purchased by the utility, in essence having the electricity meter run backwards. Net metering is authorized by NH RSA 362-A:9, and New Hampshire's rules may be found at www.puc.state.nh.us.

8.2.6.2 Environmental Disclosure of Electricity Attributes

The New Hampshire Public Utilities Commission has recently begun work to develop rules for environmental disclosure for electricity suppliers operating in New Hampshire. Once adopted, it is anticipated that these rules will provide ratepayers with information on the type of electricity generation we use, and the emissions associated with this electricity. By providing ratepayers with this information, they will have a better understanding of the environmental impacts of our energy use, and allows us to use environmental factors as one criterion when selecting an energy supplier.

8.3 Results of Policy Tests Compared with the Base Case

In order to understand some of the impacts of renewable energy upon the energy, environmental and economic future of New Hampshire, two scenarios were tested against the "Base Case:"

- Retention of the wood-fired power plants after expiration of their rate orders; and
- Development of commercial scale wind farms in New Hampshire.

The results of these scenarios are described in detail below. It should be noted that members of the public suggested a large number of possible renewable power scenarios, and only a limited number could be tested. Both of these scenarios are presented for information purposes, and should not necessarily be considered recommendations.

8.3.1 Retention of Wood Energy Plants Current Rate Orders

New Hampshire currently has five wood-fired steam turbine power plants, or "biomass plants," operating in the state. Three others have closed following termination of their rate orders. The locations and generating capacity of each of these plants are listed below. These plants were constructed following the era of rapidly rising oil prices in the 1970s, and were granted rate orders for long-term guaranteed power sales at rates that have turned out to be significantly above market prices. These rate orders, which are 20 years in length, are scheduled to expire during the next five years, as summarized in Table 8.3 below.

Table 8.3. Biomass Historical Generation and Rate Order Expiration Dates

Plant Location	Historical Generation	Rate order expiration date	Modeled expiration timing
Bridgewater	15 MW	8/31/2007	end of 2007
Springfield	13.8 MW	11/30/2007	end of 2007
Bethlehem	15 MW	11/30/2006	end of 2006
Tamworth	20 MW	3/31/2008	end of 2007
Whitefield	13.8 MW	3rd Q 2003*	end of 2003

* anticipated closure date, rate order already terminated

New Hampshire also has three wood-fired power plants that closed after their rate orders were bought out. These facilities and their historic generation levels are Bio-Energy in Hopkinton (11 MW), Alexandria Power in Alexandria (15 MW), and Timco in Barnstead (4 MW).

While the electricity from these plants has been expensive, they have also brought important benefits to the state. Each plant employs people directly, and in addition, they provide a market for low-grade wood and biomass, which has several secondary benefits.

The biomass plants pay an average of $18 per green ton of wood chips from logging and chipping of low-grade trees. These are trees that are not of high enough quality to be sawn into lumber, or have other commercial defects. If they are not harvested for chips and burned at the biomass plants, they continue to grow, shading out other trees that might grow straight and tall and become high value timber. As a result, the loss of the market for chips would significantly reduce the level of such "thinning" activity that takes place in New Hampshire's forest, with the long-term result that the value of standing timber and the supply of marketable timber would be reduced.

The market provided for whole tree chips by the wood energy plants is important to the state's forest industry and forest landowners. In 2002, the New Hampshire Department of Resources & Economic Development commissioned a report on the market for low-grade wood provided by the wood energy plants. This report, available at www.nhdfl.org, identifies the following benefits of the low-grade wood market these plants provide (figures include benefits from Bio Energy in Hopkinton, an 11 MW plant that has closed since the release of the DRED report):

- The plants have a direct and indirect economic impact of roughly $96 million each year. Of this, an estimated $70 million in economic activity is tied directly to the harvesting and processing of fuel for the facilities.
- The wood-fired power plants are responsible for between 213 and 444 jobs in the state. Most of these jobs are related to forest management or timber harvesting and transportation.
- Markets for low-grade wood are important to sustainable forest management, diverse wildlife habitat, and the conservation of open space.
- New Hampshire's sawmills rely upon wood energy plants for a residue market. Sawmills in the state have tripled their production from the early 1980's to today, and New Hampshire mills now produce an estimated 400,000 to 600,000 green tons of mill residue each year.

Table 8.4. Direct Economic Impacts of Biomass Plants in New Hampshire

Direct Economic Impacts of Biomass Plants in New Hampshire, 1999					
Plant	**KWh / year**	**MW**	**Estimated no. of jobs**	**Estimated wages & benefits**	**Estimated property tax**
Bridgewater	124,830,000	15.0	32	$1,432,453	$ 200,000
Hemphill	114,843,600	13.8	29	$1,317,857	$ 200,000
Whitefield	114,843,600	13.8	29	$1,317,857	$ 200,000
Bethlehem	124,830,000	15.0	32	$1,432,453	$ 200,000
Tamworth	166,440,000	20.0	42	$1,909,938	$ 200,000
Totals	***645,787,200***	***77.6***	***165***	***$7,410,559***	***$1,000,000***

As a market for sawmill waste, the plants also pay roughly $15 per green ton of sawmill residue. Without this market, the sawmills' next best option is to pay $35 per green ton to dispose of the sawmill residue – a cost increase of $50 per ton, and increase to our state's waste stream. As the sawmills now sell to the wood fired power plants over 100,000 tons of sawmill residue, the loss of the biomass plant market would cost the state's sawmills in excess of $5 million per year, reducing their profitability and competitiveness.

Table 8.5. Prices & Amounts Paid by Biomass Plants for Chips & Sawmill Residue

Plant	Tons of Chips Used	Chip Purchases ($18/ton)	Sawmill Residue (Est. green tons)	Residue Purchases ($15/ton)	Disposal ($35/ton)	Lost Sawmill dollars
Bridgewater	229,320	$ 4,127,760	22,932	$ 343,980.00	$ (802,620)	$(1,146,600)
Hemphill	207,577	$ 3,736,386	20,758	$ 311,365.50	$ (726,520)	$(1,037,885)
Whitefield	187,392	$ 3,373,056	18,739	$ 281,088.00	$ (655,872)	$ (936,960)
Bethlehem	226,600	$ 4,078,800	22,660	$ 339,900.00	$ (793,100)	$(1,133,000)
Tamworth	286,178	$ 5,151,204	28,618	$ 429,267.00	$(1,001,623)	$(1,430,890)
Totals	***1,137,067***	***$20,467,206***	**113,707**	**$1,705,600.50**	**$(3,979,735)**	**$(5,685,335)**

The wood plants also burn an indigenous renewable resource. While the combustion of wood does produce air pollutants such as particulates and NOx, it is not a netsource of the greenhouse gas CO_2 as long as the wood supply is continually re-growing, versus being lost to other types of land uses. In New Hampshire, the state presently grows more trees than are removed through harvesting or lost to development. Trees absorb CO_2 from the air during growth, which is released when the wood is combusted or when the wood decays naturally in the forest. As a result, wood is widely considered to be a "CO_2-neutral" fuel – that is, its combustion and re-growth leads to no net increase in atmospheric CO_2 emissions over the long term when the supply is continually re-grown in a sustainable manner.

Based on the set of considerations outlined above, it is of interest to some industries, landowners, and policy makers in the state to understand the potential benefits and costs that might be associated with alternatives to retirement of the state's biomass plants over the next five years. For this reason, we have studied the impacts of retaining the plants in operation.

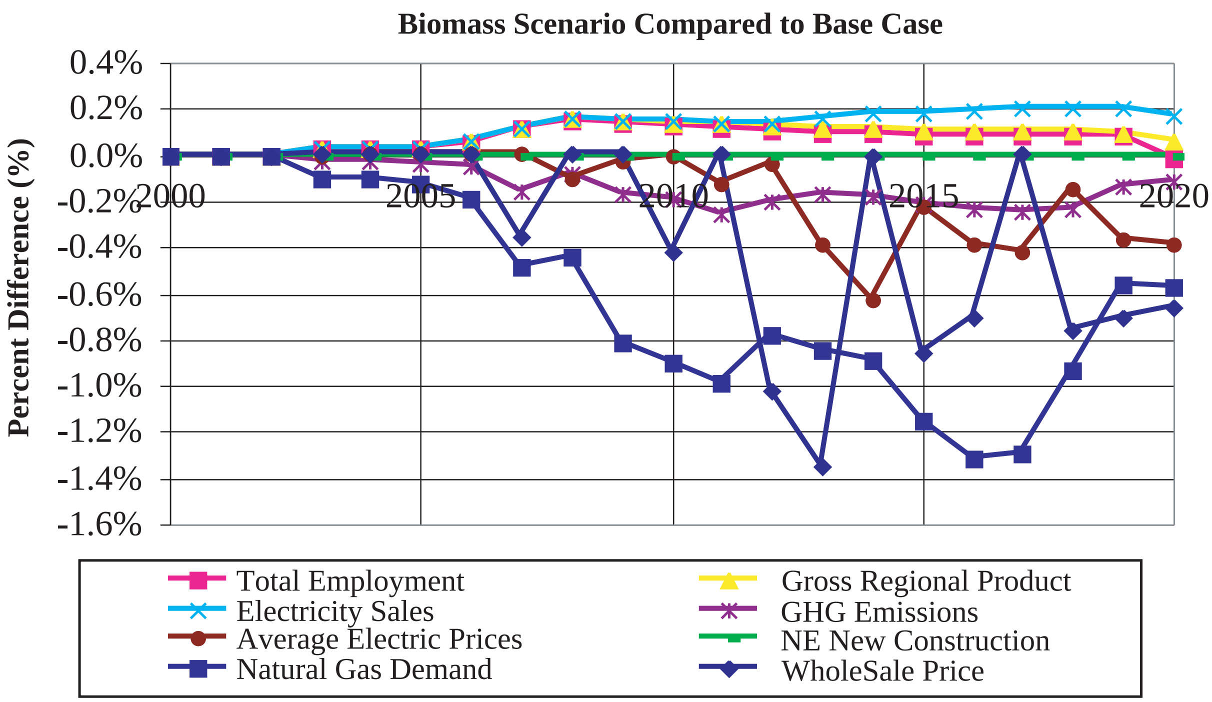


Figure 8.7. Impacts of Biomass Plant Retention Relative to Base Case

The report completed for the New Hampshire Department of Resources & Economic Development estimated that – if operating constantly – fuel, operations and maintenance for a wood-fired power plant cost roughly 5.4 cents per kWh. This figure does not include profit or contingencies. For the purposes of this report, it is assumed that in order to cover all expenses associated with wood-fired power, including profit for the operator and contingency expenses, the electricity would need to be sold for 5.8 cents per KWh. The evident conclusion is that for at least the next ten years, some sort of program would be required to make up the difference between expected annual average wholesale prices and the price for profitable operation.

Rather than specify and simulate a specific mechanism for bridging the gap between wholesale and break-even prices, we have simulated a scenario which retains the plants, quantifying the energy and economic impacts of doing so, as well as the annual electricity price gap which would need to be bridged to operate the plants profitably. The results of this simulation are intended to identify both the costs and the benefits of retaining the plants, as an input to policy formulation on the part of interested stakeholders, and to build upon the work of the recent Legislative study committee charged with consdering these issues.

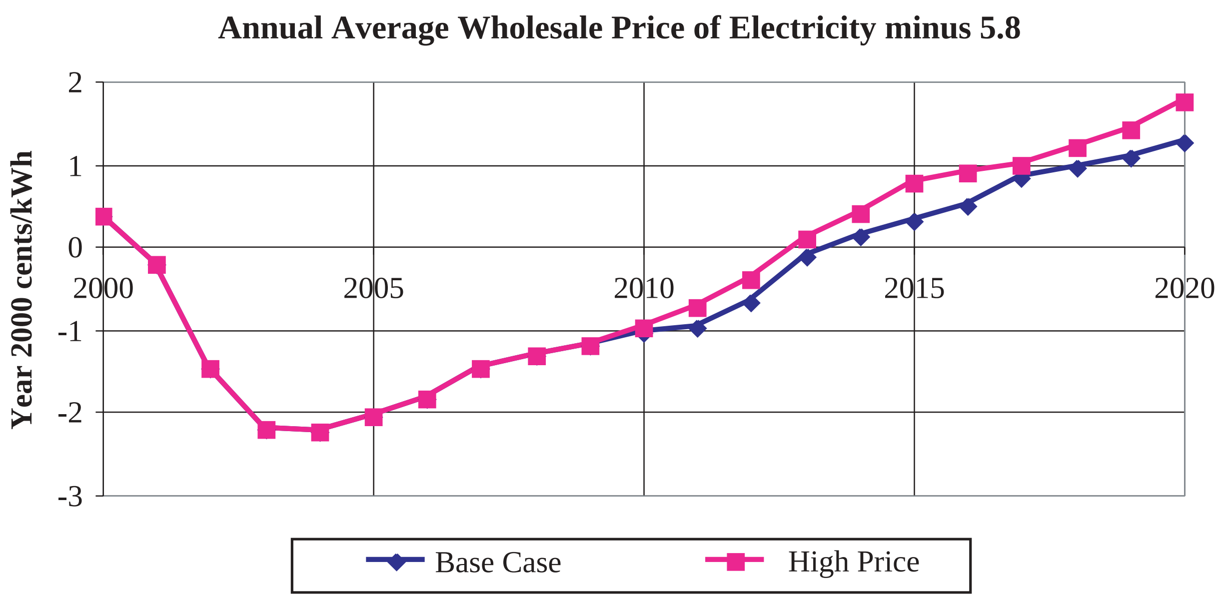


Figure 8.8. Difference in Wholesale and Break-even Electricity Prices

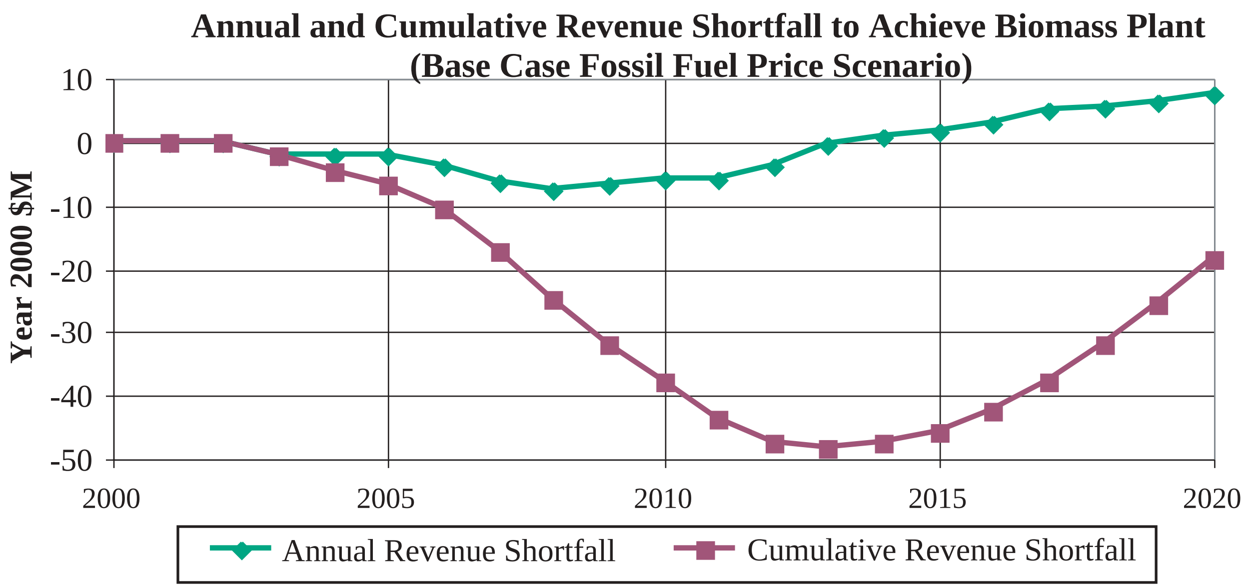


Figure 8.9. Annual and Cumulative Revenue Shortfall to Achieve Biomass Plant Operation

The elements of the simulation are as follows:

• The plants continue to operate through 2020, rather than closing as assumed in the Base Case;

• The plants sell their power at the wholesale price, not at 5.8 cents/KWh;

• The employment and payments to logging and sawmills are phased into the base case economic forecast based on plant retention rather than retirement.

We do not, in the present simulation, attempt to account for the potential economic effects of plant-enabled forest management activity that increases the value of standing timber over time. This is an important benefit, but one which is difficult to quantify.

Table 8.6. Seasonal and Annual Base Case Wholesale Electricity Price Forecast

Base Case Forecast New Hampshire Average Wholesale Price ($/MWh)					
	2000	**2005**	**2010**	**2015**	**2020**
			Nominal Dollars		
Summer	68.78	50.92	74.20	107.76	137.28
Winter	54.21	34.01	50.42	76.20	107.02
Annual	61.61	42.58	62.46	92.17	122.33
			2000 Dollars		
Summer	68.78	44.79	56.84	71.91	79.80
Winter	54.21	29.91	38.63	50.85	62.20
Annual	61.61	37.45	47.85	61.51	71.11
			Real Cumulative Growth Rate (%)		
Summer	0.0%	-6.0%	0.8%	3.0%	3.5%
Winter	0.0%	-9.3%	-0.7%	2.3%	3.4%
Annual	0.0%	-7.4%	0.1%	2.7%	3.4%

The impacts of the plant retention, relative to the Base Case forecast, are displayed in Figure 8.7. The retention of the plants serves to avoid slight (perhaps 6 tenths of a percent on average) increases in wholesale electricity prices that would otherwise occur; as a result, this impact is shown as a modest reduction in wholesale prices relative to the Base Case. Some new natural gas generation is avoided, and retail electricity prices are also slightly lower (by 2-3 tenths of a percent on average) than in the Base Case. The plants provide economic benefits as shown in Table 8.7. Note that the dip in the economic benefits relative to the Base Case dip in the year 2020; this is because, in the absence of the biomass plants, the model forecasts new plant construction in the last years of the simulation, which would bring jobs to the state. By slightly reducing the wholesale price of electricity and thus delaying new plant construction until after the forecast horizon, retention of the biomass plants also delays the new plant construction jobs to later years. Retaining the plants reduces greenhouse gas emissions by two tenths of a percent relative to base case, or roughly 100 thousand tons of CO_2 per year.

Table 8.7. Employment Impacts of Biomass Plant Retention

Total Employment (Thousands)						
	2000	2005	2010	2015	2020	20-Year Average
Base Case Comparison						
Base Case	699.797	741.202	777.134	813.023	842.421	**779.501**
Biomass	699.797	741.387	778.078	813.736	842.299	**780.077**
Difference	0.000	0.185	0.944	0.713	-0.122	**0.576**
Percent Change	0.00%	0.02%	0.12%	0.09%	-0.01%	**0.07%**
High Price Scenario Comparison						
High Price	699.797	741.202	773.287	806.896	846.290	**776.937**
Biomass HP	699.797	741.387	774.230	807.651	846.481	**777.529**
Difference	0.000	0.185	0.943	0.755	0.191	**0.592**
Percent Change	0.00%	0.02%	0.12%	0.09%	0.02%	**0.07%**

Finally, we examine what it would cost to achieve the benefits of biomass plant retention, by examining the gap between the forecast wholesale price of electricity (in the presence of the plants) and the price of 5.8 cents per KWh (2000 dollars). The results are plotted above in Figure 8.9. There is a gap from the present until either 2013 or 2014 depending upon the (fossil) fuel price forecast scenario. After this cross over point, the wholesale price rises and stays above the break-even price point.

The price gap times the electricity generation from the biomass plants yields an estimate of the revenue shortfall or amount needed to keep the plants open. Recall that three of the plants' rate orders expire in 2007, one in 2006, and one ceases operation in 2003, as discussed above. In order to estimate the annual revenue shortfalls, we multiply the "artificially retained" annual biomass plant generation (which phases in over time between 2003 and 2007) by that year's price gap.

The annual revenue gap drops to its most negative value of $7.7M in 2008, and becomes positive in 2014. The cumulative revenue shortfall dips to its lowest value just shy of $50M in 2013, and thereafter rises back towards parity. The implication is that if the biomass plants were guaranteed a price of 5.8 cents per KWh until approximately 2023, then the net price support over the 2003 - 2023 time period could be zero. Of course, it must be remembered that this estimate and analysis is based on forecasts of wholesale electricity prices, and it is faulty forecasts of energy prices that led to the original rate order contracts in the first place.

In conclusion, we have analyzed and described the costs and benefits of retaining the biomass plants in operation past the scheduled expiration of their rate orders. One of the major benefits of plant operation – increased forest management activity and its impacts on long-term value of standing timber in the state – has been mentioned but not quantified. Retaining the plants would provide for retaining 700-950 jobs, and help the state's growing sawmill industry. It would require some type of supplement starting in 2003, when wholesale electricity prices are below the estimated 5.8 cents per KWh break-even price for profitable operation of the plants. Any policy that makes a commitment to provide a supplement to fill the gap between wholesale prices and a break-even price would be a commitment to an uncertain amount, since it relies on a forecast of wholesale electricity prices.

It must be noted that while this analysis considers the energy, economic and environmental benefits associated with continued operation of the wood-fired power plants, the costs are not fully considered. This is because a funding source for continued operation of the facilities (e.g., a Renewable Portfolio Standard, a tax on electricity, or revenue from the state's general fund) was not identified, and was not used in the model. Prior to creation of any policy to support continued operation of the wood-fired power plants, the costs would need to be weighed against the benefits.

8.3.2 Establishing Wind Farms in New Hampshire

The State's Wind Resource

Northern New England, including New Hampshire, has a considerable wind resource. The technology for wind turbines has developed rapidly in recent years, so that utility-scale sites of wind turbines (so-called "wind farms") are now competitive with conventional (e.g., fossil fuel based) generation.

Around the world, over 50,000 wind turbines are currently in operation.[1] In the last six years, 1,100 MW of new wind generation has been established in Texas alone. Wind turbines have been generating electricity in the US for decades, but they have remained at least until now, a niche technology, accounting for less than 1% of US electricity. With recent advances in technology that improve wind power's economics, the role of wind energy is advancing rapidly. Last year alone, 1,700 MW of new wind capacity was installed in the US, doubling total US wind power capacity.[2] This is an amount equal to 60% of New Hampshire's total capacity in 2000, or roughly the capacity of Seabrook plus the state's coal power plants combined. And in 2002 alone, approximately $3 billion in wind power projects were proposed or planned for the next several years at sites in the Midwest, New Jersey, New York, and New England.

The following paragraph, excerpted from the National Renewable Energy Laboratory's Wind Energy Atlas, describes the wind power resource in New England:

> *An extensive area, including most of Vermont and New Hampshire, as well as much of Maine, Massachusetts, and Connecticut, has annual average wind power of class 3 or higher on exposed locations. Highest powers (class 5 and 6) occur on the best-exposed mountain and ridge tops in Vermont's Green Mountains, New Hampshire's White Mountains, and Maine's Longfellow Mountains. The remainder of the hilltops and mountain tops in this area that are outside of these major ranges have class 3 or 4 wind power. At the highest elevations this wind power increases to class 6 and 7 in the winter. Average wind speeds may vary significantly from one ridge crest to another and are primarily influenced by the height and slope of the ridge, orientation to the prevailing winds, and the proximity of other mountains and ridges. For example, the White Mountains are indicated to have class 6 wind power, but Mount Washington, at 1,917 m (6,288 ft) elevation, is known to have considerably greater wind power as a result of terrain-induced acceleration as the air passes over the mountain.*

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[1] *Washington Post*, August 20, 2002: "Windmills on the Water Create Storm on Cape Cod," page A3.
[2] *Technology Review*, July/August 2002, pp. 42-45.

Also from the Wind Energy Atlas is a map of the wind energy resource in New Hampshire and Vermont.

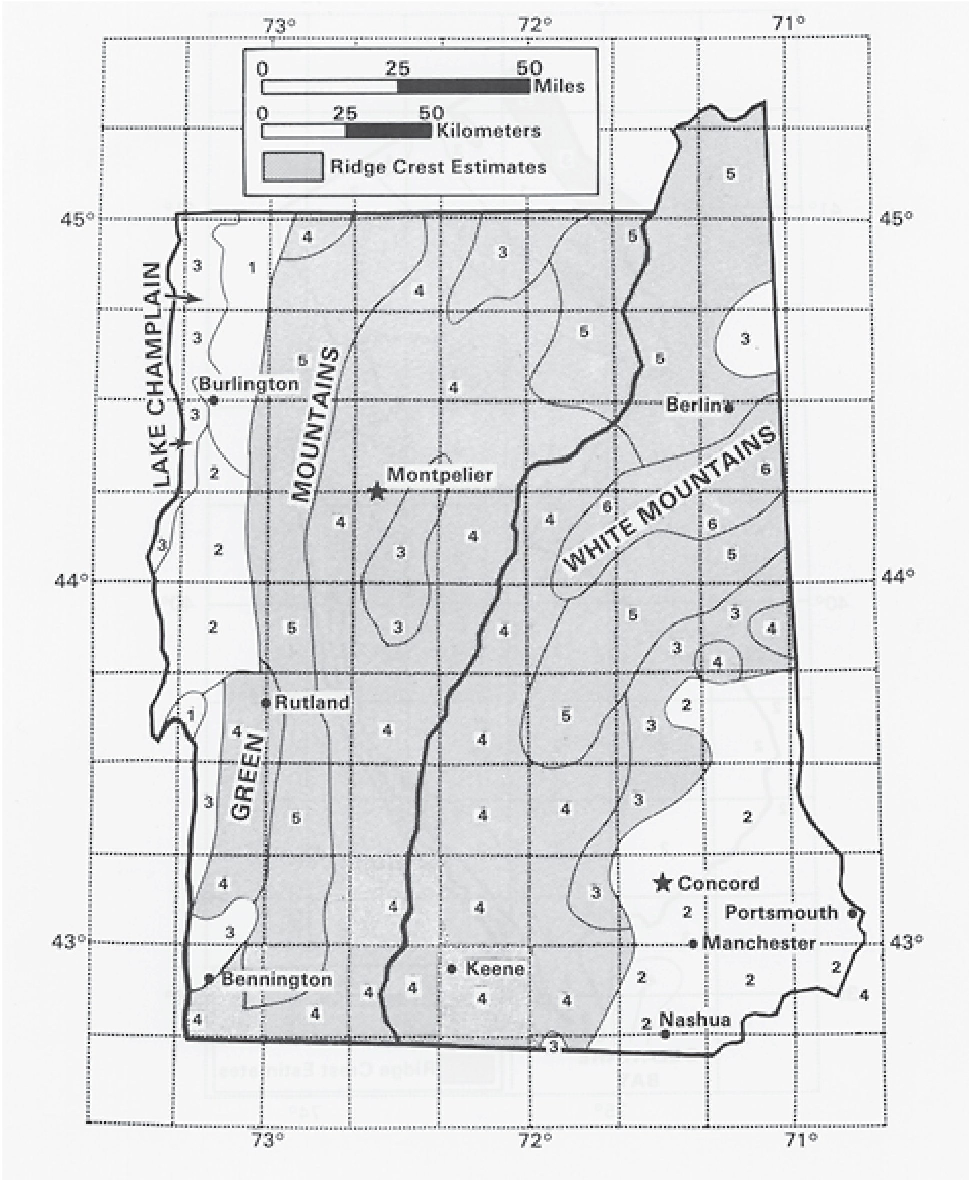

Figure 8.10. Wind Energy Resource Map for New Hampshire and Vermont

While there is strong potential for siting wind farms in the state, they also raise numerous concerns. It is likely that areas that could support wind power may face the following obstacles:

- **Distance to the electricity grid:**

  Many of the sites potentially available for wind generation are remote, and would require investments in new infrastructure to make certain that power produced could reach the electricity power grid in an efficient manner.

• **Ownership:**

Many of the ridgelines with the altitude and aspect necessary to generate reliable wind power are on public land, most notably the White Mountain National Forest. Current forest policies do not allow siting of wind farms in the National Forest, and any effort to change this may encounter significant resistance.

• **Aesthetics:**

New Hampshire is known for its open space and views. While many find wind farms visually attractive, many others do not. Recent opposition from citizen groups to the siting of cell towers suggest that a company wishing to establish a wind farm in New Hampshire would need to work closely with the State, local communitites and other interested parties to address these concerns.

• **Habitat concerns:**

Many of the areas in New Hampshire most likely to have suitable wind are high-elevation ridge lines. High elevation sites often have the least human impact, are distant from roads and buildings, and have relatively undisturbed ecosystems. These issues would clearly need to be considered prior to establishment of a wind farm.

However, it is important to note that many projects have addressed all of these issues. One example is the wind farm in nearby Searsburg, Vermont, owned by Green Mountain Power and managed by Vermont Environmental Research Associates.[3] The project includes 11 turbines that produce 6 megawatts of power for the New England grid.

In this section we describe a basic simulation that has been performed to characterize the energy, environmental, and economic impacts of wind energy development in New Hampshire. We test the impacts of the construction of three moderate-scale wind farms in New Hampshire at 5-year intervals, so that in 2005, 2010, and 2015, wind farms of 25 MW capacity each are constructed. We model the timing of generation from these wind farms to be random and evenly distributed within days and seasons, with an availability factor of 29.05 percent based upon wind resource feasibility studies completed for Massachusetts.[4] As a result, total annual generation from a 25 MW wind farm is calculated as availability **x** capacity **x** time **=** annual generation, or:

*0.2905(availability)*25(MW)*365(days/yr)*24(hrs/day) = 63,619 MWh/yr or 63.6 GWh/yr*

3 See www.northeastwind.com/Searsburg_Project for more information on the Searsburg wind farm.
4 “Massachusetts Renewable Portfolio Standard, Cost Analysis Report,” Prepared for Massachusetts Division of Energy Resources, December 2000.

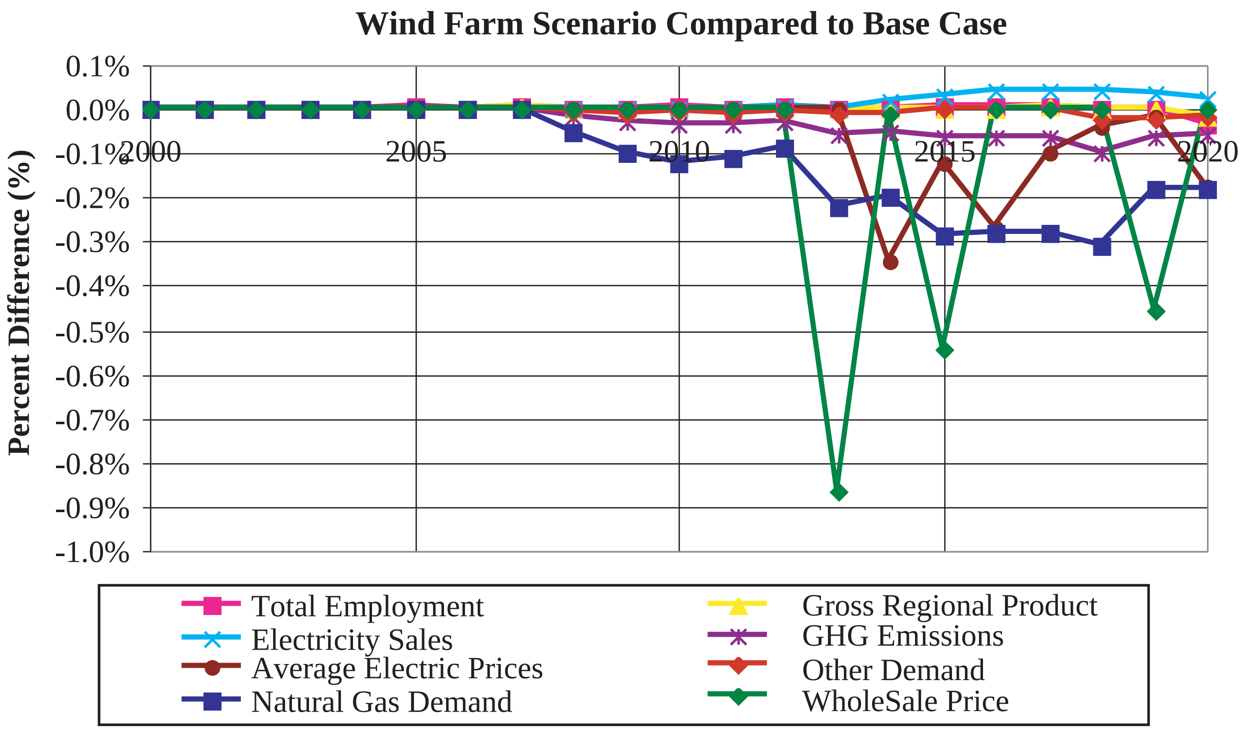

Figure 8.11 Impacts of Wind Farm Relative to Base Case

For purposes of this analysis, we assume that the wind energy units sell all power that they generate, at the average wholesale price for a given year.

The results of the wind farm scenario, relative to the Base Case, are shown in Figure 8.12. Overall, the presence of wind power lowers the wholesale electricity price by an average of 2-3 tenths of a percent between 2012 and 2020. This also has the effect of lowering the retail price of electricity by a lesser amount. The slight retail price reduction leads to a very slight increase in electricity demand in the out-years, as residences and businesses tend to invest less in efficiency at the time of new purchase, and possibly to do a bit of fuel switching to electricity.

Table 8.8 Greenhouse Gas Impacts of Wind Farms

Greenhouse Gas Emissions (Million Tons CO2e/Year)	2000	2005	2010	2015	2020	20-Year Average
Base Case Comparison						
Base Case	36.37	40.48	46.16	51.63	56.07	**46.94**
Wind Farm	36.37	40.48	46.14	51.60	56.04	**46.93**
Difference	0.00	0.00	-0.02	-0.03	-0.03	**-0.02**
Percent Change	0.00%	0.00%	-0.03%	-0.07%	-0.06%	**-0.03%**
High Price Scenario Comparison						
High Price	36.37	40.48	45.12	48.03	52.73	**45.17**
Wind Farm HP	36.37	40.48	45.10	47.99	52.65	**45.15**
Difference	0.00	0.00	-0.02	-0.04	-0.07	**-0.02**
Percent Change	0.00%	0.00%	-0.04%	-0.09%	-0.14%	**-0.04%**

The hypothetical wind power additions would reduce total annual greenhouse gas emissions in 2020 by 30 thousand tons of CO_2. As a share of the total emissions from the state, this reflects approximately 0.06%. Note that if the high price fuel scenario came to pass, the emissions gains would be considerably higher, because wind would likely displace fossil fuels such as coal which have significant air emissions.

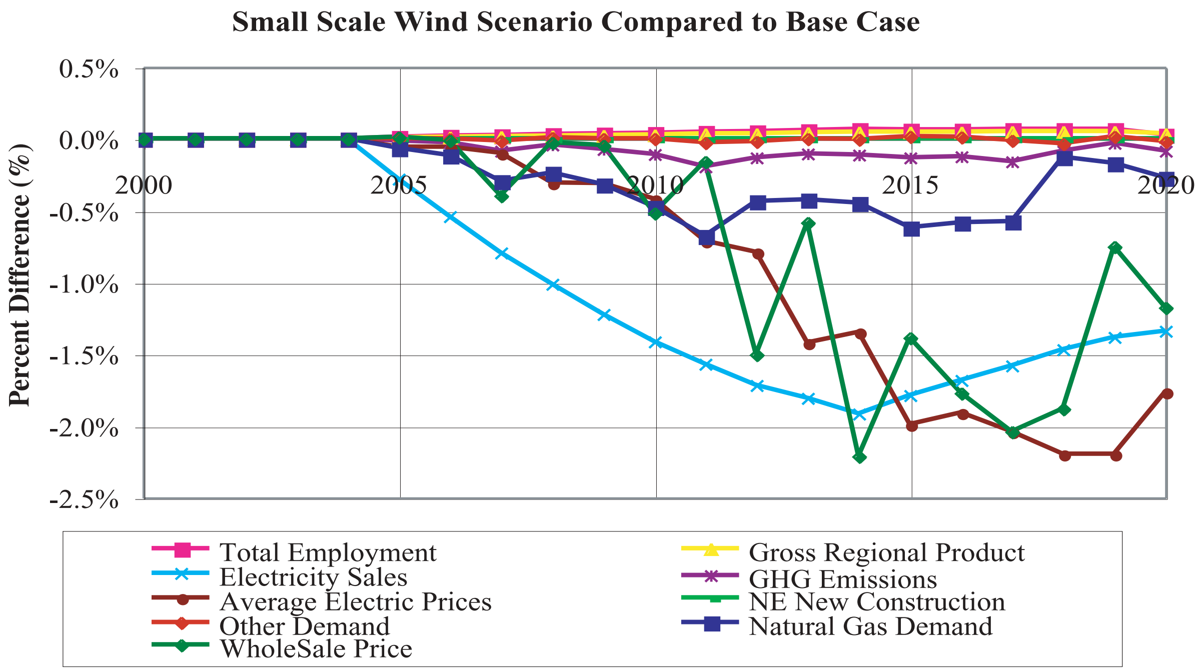

Figure 8.12. Impacts of Wind Farms on Selected Variables, Relative to Base Case

The employment impacts of wind power capacity additions are quite mixed in our modeling results. Construction of the plants generates a modest level of employment (roughly 30 full-time equivalents per year). However, because wind power additions lower the wholesale price of electricity slightly, this has the effect of delaying major plant construction that in the Base Case occurs in 2019; this delay of major new plant construction causes a very slight reduction in employment in 2020 relative to the Base Case.

Table 8.9 Employment Impacts of Wind Farms

Total Employment (Thousands)	2000	2005	2010	2015	2020	20-Year Average
Base Case Comparison						
Base Case	699.797	741.202	777.134	813.023	842.421	**779.501**
Wind Farm	699.797	741.228	777.166	813.058	842.111	**779.501**
Difference	0.000	0.026	0.032	0.035	-0.310	**0.000**
Percent Change	0.00%	0.00%	0.00%	0.00%	-0.04%	**0.00%**
High Price Scenario Comparison						
High Price	699.797	741.202	773.287	806.896	846.290	**776.937**
Wind Farm HP	699.797	741.228	773.319	806.931	845.841	**776.928**
Difference	0.000	0.026	0.032	0.035	-0.449	**-0.008**
Percent Change	0.00%	0.00%	0.00%	0.00%	-0.05%	**0.00%**

While the establishment of wind farms in New Hampshire offers potential economic and environmental benefits for the state, there are a number of issues that will need to be addressed. A starting point is to continue to refine our understanding of what parts of the state – based upon prevailing winds, elevation, aspect, ownership, distance to transmission lines, and other relevant factors included in a recent Northeast Utilities/ECS study – offer the greatest promise for wind power. With this information, the State, wind investors, environmental organizations, landowners and municipalities can engage in constructive dialogue about what sites are most appropriate for potential wind farms. By engaging in this discussion, all parties would have an opportunity to address issues of concern, and potential wind projects could be focused on the most appropriate sites.

8.4 Distributed Generation

Distributed generation refers to the production of electricity by numerous small units located at or near the sources of demand. This stands in contrast to traditional electricity generation systems, where electricity production is centralized at large installations some distance from demand, and the power must be transmitted significant distances through distributions systems such as pipelines and electric transmission wires.

There are a number of benefits associated with distributed generation, including:

• Reduced energy costs for the generator and user of electricity;

• Fewer, or even zero, transmission losses as a result of generation being sited closer to demand;

• Reduced costs associated with upgrades to transmissions and distribution systems otherwise required to handle increased load;

• Protection from major disruptions from weather or other events (ice storms, terrorism, etc.); and

• When the distributed generation uses an indigenous fuel source (e.g. wood-fired boilers at a sawmill), there are benefits to the local economy and environment.

There are concerns about the use of distributed generation, which must be carefully considered. Some forms of distributed generation generate relatively high levels of pollutants, when measured on a per KWh basis. For example, New Hampshire regulates NOx emissions from distributed generation using diesel fuel.

In the ENERGY 2020 system, all energy used for heating is a candidate for cogeneration. The cost of cogeneration is the fixed capital cost of the investment plus the variable fuel costs (net of efficiency gains). This cogeneration cost is estimated for all fuels and technologies and compared to the price of electricity. The marginal market share for each cogeneration technology is based on this comparison. Figure 8.13 shows a simplified overview of the cogeneration structure.[5]

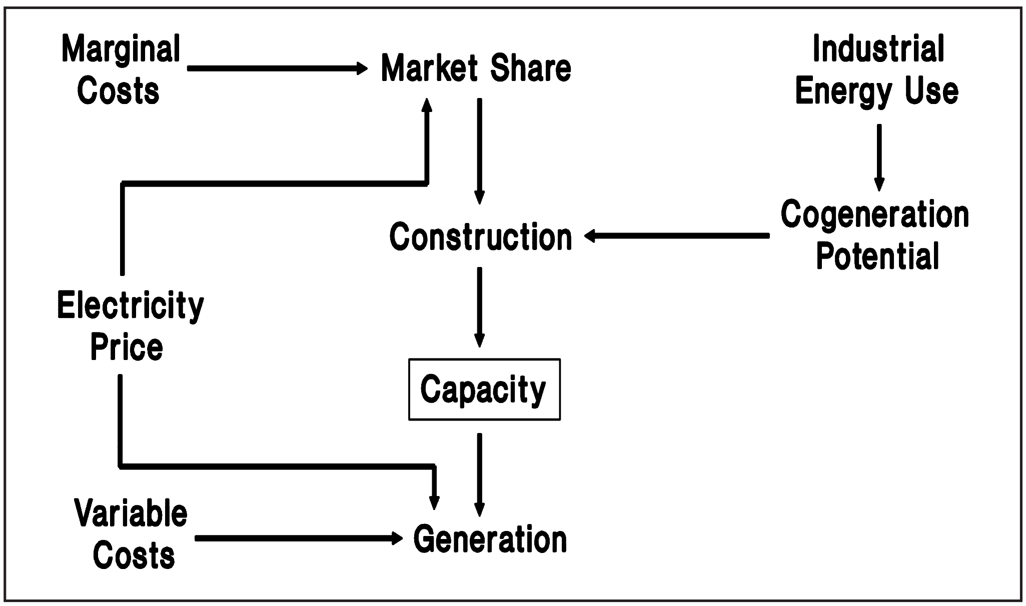

Figure 8.13. Cogeneration Concepts

As discussed above in Chapter 5, distributed energy resources have been identified as in important part of efforts to ensure that our energy infrastructure is secure and not vulnerable to attack.

5 Cogeneration is restricted to consumers who directly produce part of their own electricity requirement. Qualifying Facilities (QFs) under PURPA and LEEPA (such as NH's wood plants), which generate power for resale to the utility, are considered independently by ENERGY2020.

8.5 New Energy Technologies

The biomass, wind and solar policy scenarios were tested in an effort to better understand the role that power produced using renewable resources play in New Hampshire's energy, economic and environmental policy. Of course, there are countless scenarios using alternative energy production that could have been considered, but time and resource constraints forced the review of a representative sample. These policy scenarios are intended to help policymakers, utilities, environmental organizations and others understand the important role that renewable energy sources can have in New Hampshire.

In addition to wood energy, solar energy and wind, there are a number of alternative energy technologies – many of them using renewable resources – that could play a role in New Hampshire's future. The information below is meant to provide a brief introduction to some of these technologies, many of them expected to be commercialized in coming years.

8.5.1 Fuel cells

A fuel cell is an electrochemical system that consumes fuel, often hydrogen, to produce an electrical current. A chemical reaction converts the hydrogen to electric power, with heat and water as byproducts. Since the fuel converts directly to electricity, without combustion, it can operate at greater efficiencies than internal combustion engines. A fuel cell has no moving parts and operates like a battery that does not require recharging (but does require refueling), making it a quiet and reliable power source.

Fuel cells have been used in a variety of settings, including remote applications where self-generation of power is critical and high tech and financial institutions that require reliable, uninterruptible power. Based upon this experience, it is expected that fuel cells will become more and more widespread, with eventual use in vehicles and homes. A number of for-profit companies are actively involved in developing fuel cells for general use.

Fuel cells hold great promise for New Hampshire because they have significant efficiencies over current power production technologies; the emissions from fuel cells are lower per unit of power; fuel cells can be designed to run on renewable fuels – thus reducing our dependence on foreign oil; and they can be used for distributed generation.

8.5.2 Geothermal Energy

The earth contains a great deal of heat, mainly from processes deep under the earth's surface. This heat eventually finds its way to the surface. The temperature of near-surface heat sources determines the ways in which the heat may be used. The use of geothermal (also referred to as "ground source") heat pumps for space heating and cooling is practical throughout New Hampshire. In these systems, energy – typically electricity – is used to move heat out of the Earth into living space during cold weather and from living space into the Earth in warm weather. The technology is the same as that used in refrigerators and air conditioners, though ground source heat pumps are designed to move heat in either direction, depending on the heating or cooling requirements in the living space.

Geothermal heat pumps offer a number of benefits for New Hampshire. First and foremost, they offer a renewable, free, carbon-neutral source for heat and cooling. From a building management point of view, they help reduce space needs by combining heating and cooling systems, have no visual impact upon architecture, and are located indoors – away from the elements and vandalism. As New Hampshire gains experience with this type of heating and cooling system, it is expected that the infrastructure of installers necessary to allow widespread use will develop.

8.5.3 Bio-fuels

In addition to using wood and municipal solid waste to produce electricity, there are a number of other ways that plant material can be used to generate energy. These include growing energy crops for either electricity production or fuel production, the use of landfill or sewer gas to produce power, and the use of plant material to manufacture bio-oil.

Energy Crops

Energy crops are plants grown specifically for use in energy production. These are differentiated from forest-derived wood or agricultural residue in that they are specifically grown for use in energy production. In New Hampshire, abandoned land eventually reverts to forest in most cases, and trees, as a fuel “crop,” are largely maintenance free. In contrast, non-forest croplands require inputs of energy and materials to prevent reversion to forest, eliminate unwanted “weed” species and to feed and irrigate the desired plant species. Energy crops include hybrid willow and poplar, switch grass, and hemp.

Energy crops are to varying degrees amenable to pyrolysis (see bio-oil discussion below), gasification, co-firing with fossil fuels or to being burned alone for energy. However, the costs of harvesting and transporting energy crops from New Hampshire’s relatively small and widely dispersed fields, coupled with a short growing season, may be a significant commercial barrier to widespread use of energy crops.

At present, it does not appear the energy crops have a strong place in New Hampshire’s future. However, use of such crops could provide some benefits to the state and its citizens, including:

- Preservation of “traditional” visual landscapes that include non-forested farmlands;
- Preservation of habitat for grassland animal species that are currently in decline;
- Maintenance and enhancement of overall biodiversity; and
- Economic support for the state’s agricultural community.

Because of these benefits, policy makers should continually monitor the evolving potential for energy crops to play a role in New Hampshire’s energy diversity.

Hemp as an Energy Crop

At a number of public hearings and work sessions on the development of the energy plan, individuals and organizations advocated growing and processing hemp as a renewable energy source in New Hampshire. The New England Hemp Foundation presented a significant volume of information to the Governor's Office of Energy and Community Services on hemp. This information primarily concentrated on the potential to use hemp as a feedstock in pyrolisis, for the production of "bio-oil." The potential to produce bio-oil using other biomass feedstocks is currently being researched in New Hampshire. Federal law currently prohibits the growing of hemp.

Bio-Oil

Bio-oil is the product of fast pyrolysis, where biomass material is rapidly heated in a controlled setting. This process produces a liquid (often referred to as "bio-oil"), char, and gasses. Proponents of bio-oil suggest that this technology has a number of advantages over traditional combustion of biomass for electricity, including the ability to store and transport bio-oil and the ability to produce "green" chemicals. According to the USDOE National Renewable Energy Laboratory, bio-oil is in a "relatively early stage of development," with a number of issues to be addressed prior to widespread acceptance and use.

The Governor's Office of Energy and Community Services has begun an 18-month feasibility study to determine the potential for the production and use of bio-oil in New Hampshire. This study, conducted in partnership with numerous economic development, forestry and academic institutions throughout New Hampshire, will evaluate the environmental, economic and energy feasibility of manufacturing bio-oil in New Hampshire. This study is expected to look at "waste" wood from forestry and sawmill operations as the primary feedstock for bio-oil. It is hoped that this initial analysis will identify ways to bring increased production of bio-based fuels to New Hampshire.

Farm Waste (Manure Digestion Gas)

Farm waste refers to crop residues and animal manures. In New Hampshire, crop residues such as corn are not available for energy use without competing with existing uses. Animal wastes, which emit gasses that can be burned to generate electricity, present a variety of problems, including:

- odor nuisance;
- organic and bacterial pollution of streams by runoff;
- nutrient loading of soils and waters;
- costly measures to meet increasing stringency of waste management requirements.

At the same time, animal wastes are a potential source of energy and should continually be considered as a possible fuel source. In addition to the challenges above, the dispersed nature of New Hampshire agriculture presents challenges, in that there are likely few farms with enough farm waste to make energy production an economically attractive use of waste. This gas can be and is being burned in other states to generate electricity.

Landfill Gas

This gas is produced by the action of microbes on organic matter in the oxygen-free environments of capped landfills. There are currently three sites in New Hampshire where landfill gas is being burned to generate electricity – taking advantage of a free fuel source. Gas is present in landfills and not utilizing it only adds more methane, a potent greenhouse gas, to the atmosphere as the gas leaks out of the landfill. As landfill gas utilization technology develops, it may become economically feasible for smaller landfills to beneficially manage their landfill gas.

Sewer Gas

As with landfill gas and manure digestion gas (farm waste), this gas is produced by the action of microbes in oxygen-free portions of sewage treatment facilities. It has the same advantages and disadvantages as landfill gas, but there is an additional advantage: it can provide at least some of the heat and/or power required to operate the sewage treatment facility. As this is a developing technology, it may not yet be commercially practical to use sewer gas for electricity production at facilities that serve less than 50,000.

8.5.4 Small-scale Wind Power

In addition to utility scale "wind farms" as discussed earlier, another application for wind power in New Hampshire is small-scale distributed wind generation. In contrast to the large turbines of today's most economical wind farm technology — which can range 1 MW or more per turbine — small-scale wind turbines are much smaller, with a capacity of 10-50 kW andblade diameters of 20-30 feet. Individual residential and small commercial customers with 1 acre or more of land and a minimum wind resource of Class 2 (which includes the entire state) will in many cases find small-scale wind to be economically viable.

As with large-scale wind power, the current pace of technological change is rapid, and is bringing wind energy costs down considerably. The market for small-scale wind turbines (defined as units up to 100 kW capacity and up to 60-foot rotor diameter) has recently been growing at the rate of 40% per year.

The use of small-scale wind power is one way that an individual family or business can make direct use of clean, renewable energy. By taking advantage of the state's net metering law, which allows unused power from small power generators to be sold into the electricity grid, owners of small-scale wind generators may be able to help offset the capital cost of a wind turbine with energy cost savings. In addition to the benefits a family or business may enjoy from generating their own electricity, the use of small scale wind is emission free and adds diversity to the state's energy system.

8.5.5 Residential Solar Hot Water Heating

Solar hot water heating is a cost effective technology that has been commercially available for decades. With a solar hot water system, sunlight heats a working fluid (propylene glycol, a common form of anti-freeze) within a set of panels that are usually installed on a roof. The fluid is then circulated to pre-heat water entering the domestic hot water system, and this pre-heated water is held in an insulated tank, ready to be called upon as input to the standard (e.g., electricity or fuel-fired) hot water system. By pre-heating this input water, the requirements for electricity or fuel input are significantly reduced.

As with small-scale wind power, solar hot water is an excellent opportunity for individuals to use clean, renewable energy in their daily lives. In the Northeast, domestic hot water heating is typically the second-highest energy cost in a household. Using solar energy to pre-heat water can reduce energy associated with heating water by up to 65 percent. Using a solar hot water heater can significantly reduce an individual's footprint on the environment. According to the U.S. Environmental Protection Agency, using one 120 gallon solar hot water heater in New Hampshire helps avoid 21 pounds of NOx, 61 pounds of SO_2, and 10,966 pounds of CO_2 emissions annually. For carbon emissions alone, the EPA estimates that the avoided emissions are equivalent to driving an average car almost 14,000 miles. As a result, the installation of these small systems can have great environmental and energy benefits to the state.

8.6 Bringing New Fuels and Technogies to New Hampshire

Renewable energy and emerging energy technologies hold significant promise for New Hampshire economy, environment, and energy infrastructure. The technologies discussed above, as well as manyothers, should be continually monitored to facilitate their use in the state. New Hampshire has long used renewable energy and innovative technology to help secure the state's energy diversity, and should continue to do so. Working with others in government and the private sector, the Governor's Office of Energy & Community Services has worked to bring innovative technologies to New Hampshire through demonstration projects, feasibility studies, and technical assistance. In addition, as we move into a fully restructured electricity market, ECS should continue to work toward policies that allow renewable energy and emerging technologies access to the electricity market in a way that adds to our current energy mix, while providing economic and environmental benefits to the citizens of New Hampshire.

8.7 A Renewable Portfolio Standard for New Hampshire

A Renewable Portfolio Standard, or RPS, is a regulatory requirement that any supplier of electricity must derive a portion of that electricity from renewable resources. What qualifies as renewable is typically set through legislation or administrative rules, and may change as the standard is phased in to encourage development of new technologies. A renewable portfolio standard assures that all consumers

Table 8.10 Status of States Relative to Renewable Energy Portfolio

State	Qualifying Generation	% Required	Notes
Maine	Solar, Wind, Biomass, Hydro, Waste, "efficient resources" (including some coal)	30%	Prior to enactment of the RPS, roughly 45% of Maine's generation came from renewables
Massachusetts	New generation, including solar, wind, biomass, fuel cells, wave and tidal	1% in 2003, increasing to 4% in 2009	Companies unable to secure sufficient renewable power contribute to the state's Renewable Trust Fund, which helps finance new renewable projects
Connecticut	Solar, landfill gas, wind, hydro, fuel cells, biomass, waste	6% in 2000, increasing to 13% in 2009	Has two classes of renewable in order to encourage new, low emission generation
Arizona	Solar, wind, biomass, hydro, geothermal, waste	0.2% in 2001, increasing to 1.1% in 2007	Requires 50-60% of generation come from solar
Nevada	Solar, wind, biomass, geothermal	5% in 2003, increasing to 15% in 2013	Requires 5% of generation to come from solar
California	Solar, Landfill Gas, Wind, Biomass, Hydro, Waste	1% in 2002, increasing to 20% by 2017	
Iowa	Solar, wind, biomass, hydro, waste	105 MW for two utilities	
Texas	Solar, landfill gas, wind, biomass, hydro, geothermal, wave, tidal	400 MW in 2002, increasing to 2,000 MW in 2009	
Wisconsin	Solar, wind, biomass, hydro, geothermal, fuel cells	0.5% in 2001, increasing to 2.2% in 2010	
Pennsylvania	Solar, wind, biomass, low-head hydro, geothermal, wave, tidal	2.0% in 2000, increasing 0.5% annually	Required to participate in competitive default service
New Jersey	Solar, landfill gas, wind, biomass, hydro, geothermal, fuel cells, waste, wave, tidal	2.5% in 2000, increasing annually	Has two classes of renewables, with different percentage requirements

of electricity contribute to the environmental and economic benefits provided by renewable energy generation, while providing a system that delivers renewable energy to consumers in a cost-efficient manner.

The establishment of an RPS guarantees some market for the generation of renewable power, and spreads the burden of "above-market" costs associated with renewable power to all ratepayers, based upon their energy consumption. By allowing different renewable generators and technologies to compete against one another, consumers have access to least-cost renewable power, encouraging renewable power generators to be as efficient as possible.

At least eleven states, including three in New England, have established a Renewable Portfolio Standard. States have taken a variety of approaches to how renewable power is defined and how much renewable power is required to meet the portfolio standard; see table 8.10 for details.

The establishment of a Renewable Portfolio Standard was considered in New Hampshire in 2001, when House Bill 718 was heard. The legislature eventually opted instead to enact a voluntary "green transition service" option that can be offered by New Hampshire's deregulated electric distribution utilities.

Since the RPS was rejected in New Hampshire, the regional Generation Information System (known as "GIS"), a system that allows tracking of attributes of electricity generation, has been completed and is now being used. The GIS tracks emissions, fuel source, and eligibility for the RPS requirements in states in our region that have an RPS in place. The PUC is drafting Environmental Disclosure Rules, which will provide information to customers on the sources of the power that we use in our homes and businesses. Several of our electric utilities are considering taking advantage of the "green transition service" option, which would utilize the GIS system and allow customers to choose a portion of their electric bill that will go to clean, renewable sources of power. While these steps are important, they are not enough to allow New Hampshire to fully realize the many important benefits of renewable energy sources.

It is now appropriate for the Legislature to reconsider the RPS, and to create a standard that meets our state's renewable energy goals: to help support existing indigenous renewable generation such as wood and hydro; to encourage investments in new renewable power generation in the state; and allow us to benefit from the diversity, reliability and economic benefits of clean power. Creating mechanisms to support renewable power also increases our energy security and reduces our dependence on foreign oil.

By enacting an RPS now, New Hampshire can reap the benefits of renewable power, as other states in the region have already done. Before this is accomplished, however, a number of issues must be considered that will impact the implementation and success of such a program. These issues include:

- What is the appropriate definition of renewable power for purposes of an RPS, and how can this impact existing renewable generators and construction of new generation?
- What percentage of renewable power will each provider be required to purchase, and will this increase over time?
- What legal issues exist regarding electrical generation outside of New Hampshire participating in the state's RPS?
- What are the anticipated impacts on the retail price of electricity?

While these issues need to be addressed, we can learn from the experiences of other New England states like Massachusetts and Maine that already have an RPS in place. For example, the newly developed Generation Information System (GIS) used by ISO New England would help overcome some administrative obstacles, including tracking of energy sources, which have served as challenges in other areas that use an RPS.

In a restructured electricity market, an RPS is the most efficient way to assure that existing renewable generation has the ability to compete, and that new renewable generation can be built. Allowing renewable generators the opportunity to compete against one another, with a guaranteed market for some fixed level of renewable generation, protects ratepayers while promoting environmental stewardship and energy security.